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EXPERIMENTAL INVESTIGATION ON REUSING A DIFFERENT TYPES OF WASTE WATER TO PREPARE CONCRETE

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ABSTRACT:

As a sustainable approach this project is conducted to study the possibility of reuse of waste water in concrete, concrete is the most widely used construction material in the world. Production of Portland cement used in concrete produces 2.5 billion tone of carbon dioxideandothergreenhousegasesworldwide.Inadditionconcreteisoneofthelargestwater consuming industries. Approximately about 150 liters of water is required for per cubic meter of concrete mix. Demand of fresh water by the construction sector is expected to increase due to high increase in the growth of construction activities in India. Without considering theother applicationsofwateratttheconcreteindustry,waterisacriticalenvironmentalissueandwater supplies, water quality are becoming more limitedworldwide.

This project presents the reuse of waste water and potable water in concrete for both mixing and curing. Concrete in prepared for M-20 grade concrete with SNF super plasticizer for both wastewaterandportablewaterandcuredforanageof7day,14daysand28days.Compressive strength, durability properties of concrete prepared with waste water and portable water is studied

1. INTRODUCTION:

Water is a colorless and chemical substance. Water is the main constituents of earth's streams, lakes & oceans, and the fluids of most living organisms. The chemical formulae of water is H_2O, means each molecules of water contains 2 atoms of hydrogen and one atom of oxygen. It also occurs in nature as snow, glaciers, icepacks, icebergs, clouds, fog, dew, aquifers and atmospheric humidity. The following pie chart shows the availability of fresh water in theworld.

Water is mainly used for agriculture, drinking, washing, transportation, chemical uses, heat exchange, fire extinction, recreation, industries, food processing and for medical uses etc., Day by day due to less availability of clean and safe drinking watertodaynearlyabout1billionpeople don't have access to it, yet we take it for granted, we waste it and even we are paying too much

for getting pure drinking water from little plastic bottles.

Water is the main foundation for life till today so money countries are struggling for searching a fresh water. The below shown graph fives the per capita per yearly availability of fresh water from thisgraphavailabilityofwateriskeepon decreasing year by year. This graph shows the world scarcity of water. Concrete is the second industry to consume more water for preparing concrete, for hydration purpose and for curing, etc., to overcome these water scarcity problems and as a sustainability approach to the world regarding scarcity of water in our paper we used treated waste water in concrete instead of portablewater.

2. REVIEW OFLITERATURE:

In this paper "domestic waste water reuse in concrete using bench scale testing and full scaleimplementation" [1] the author used treated domestic waste water in concrete. He used primary treated waste water,secondarytreatedwastewaterand distilled water were used to cast the concrete specimen. And he concluded thatcompressivestrengthoftheconcrete produced with distilled water and secondarytreatedwastewaterismoreor less equal and the compressive strength of the concrete is reduced by up to 16.2%.

In this paper "sustainable use of resources – Recycling of sewage treatment plant water in concrete" [2] the author used treated waste water obtained from the sewage treatment plant and he concluded that as a sustainability approach the preliminary research findings suggested that significant differences do not exist between mortar cubes made of portable water versus sewage treated waste water.

In this paper "use of treated waste water for concrete mixing in Kuwait" [3] the author clearly explained about the type water used for mixing do not affect to concrete slump and density. Here he mainly considered use of water in mixing concrete and studied the propertiessuchasslumpanddensityand he concluded that there is greater difference between these two parameters.

In this paper "utilization of waste water to check strength parameters of concrete" [4] here the author reviews possibility of replacing fresh water with the waste water and he concluded that workability of the concrete goes on decreaseswiththeincreaseinpercentage of waste water and compressivestrength of the concrete is slightly increased with the increase in percentage of treated waste water inconcrete.

3. EXPERIMENTALINVESTIGATION:

CEMENT: Ordinary Portland cement 53 grade of ultra tech brand confirming to B.I.S standards is used in the present investigation. Fineness test was conducted for cement and it

was found to be 2.8% which conforms to IS 8122-1989.

COARSE AGGREGATE: Machine
crushed angular Basalt metal obtained from namakkal was used as coarse aggregate. The coarse aggregate was free from clayey matter, silt and organic impurities. The coarse aggregate was also tested for specific gravity and it was 2.72. Fineness modulus was 4.20. Aggregate passingthrough12.5mmandretainedfrom 4.75mm was used in the experimental work, which is acceptable according to IS 383-1970.

WATER: water is essentially required in concrete for complete chemical hydration of cement in concrete. Water used in concrete should be free from suspended solids,alkali,organicimpuritiesetc.,andit should be equal to drinking water quality standards or else it directly affects on the strength of concrete. In our project we prepared a concrete with portable drinking water versus treated wastewater.

SLUDGE WATER: Sludge is a semi- solid slurry that can be produced from a range of industrial processes, from **water** treatment, wastewater treatment or on-site sanitation systems.... Industrial wastewater treatment plants produce solids that are also referred to as**sludge**.

SOAP WATER: Sodium **soaps** are "hard" **soaps**. When the alkali ispotassium hydroxide, a potassium **soap** is formed. Potassium **soaps** are softer and are found in some liquid hand **soaps** and shaving creams. The carboxylate end of the **soap** molecule is attracted to **water**. It is called the hydrophilic end.

INDUSTRIAL WATER: Industrial waste is the waste produced by **industrial** activity which includes any material that is rendered useless during a manufacturing process such as that of factories, **industries**, mills, and mining operations. It has existed since the start of the **Industrial** Revolution.... (See **Industrial wastewater**treatment)

PREPARATION OF TESTSPECIMENS:

The granite powder collectedfrom polishing units was dried. As per the mix proportions, given in table-1 the quantities of various ingredients were weighed. Initially cement and granite powder were mixed thoroughly. Further sand andcoarse aggregate were added to the mix. Once all the materials were mixed well, Cubes of size150mm X150mmX150mm and cylinder were cast. The specimens were cured in curing tank for a period of 28days.

MIX DESIGN

Based on the physical properties of material and tested as per IS: 4031-1996, IS:383-1970,M25grade concrete mixwas designed as per IS: 10262-2009.Mix proportion and its details are shown in table 1 and2.

Characteristics compressive strength required in the field at 28 days =25Mpa
Maximum size of aggregate = 20 mm
Degree of workability =0.90
Degree of quality control = Good
Type of exposure = Mild
Specific gravity of cement = 3.15
Specific gravity of coarse aggregate=2.63
Specific gravity of fine aggregate = 2.6
Water absorption of coarse aggregate = 1.8%
Water absorption of fine aggregate = 1%

Table 1- Mix proportions of concrete with waste water

Mix design	Normal water	Sludge water	Soap water	Industrial water
w/c ratio	0.4	0.4	0.4	0.4
Cement content (kg)	3.8kg	3.8kg	3.8kg	3.8kg
Fine aggregate(kg)	6.6kg	6.6kg	6.6kg	6.6kg
Coarse aggregate(kg)	11kg	11kg	11kg	11kg
Water (lit)	1.70	1.70	1.70	1.70

Table 2- Compaction factor

Mix	Slump value(mm)	Compaction factor
Normal water	85	0.99
Sludge water	87	0.98
Soap water	89	0.98
Industrial water	92	0.99

4. RESULTS ANDDISCUSSION:

1. COMPRESSIVESTRENGTH

Table 3 Compressive strengths of cubes with different types of waste water in 7, 14 & 28 days

Type of water	Compressive strength in 7 days (N/mm^2)	Compressive strength in 14 days (N/mm^2)	Compressive strength in 28 days (N/mm^2)
Normal water	16	25.7	35
Sludge water	15	22.2	37
Soap water	20.8	11.7	42
Industrial water	16.8	12	38

2. SPLIT TENSILESTRENGTH

Split tensile strength of concrete is usually found by testing plain concrete cylinders. Cylinders of size 150mm x 300 mm were used to determine the split tensile strength. After curing, the specimens were tested for split tensile strength using the details of same are represented in table4.

Table 4 Split tensile strength of cylinder with different types of waste water in 7, 14 & 28 days

Type of water	Split tensile strength in7 days (N/mm^2) $x10^4$	Split tensile strength in 14 days (N/mm^2) $x10^4$	Split tensile strength in 28 days (N/mm^2) $x10^4$
Normal water	6.79	8.34	10.21
Sludge water	5.56	7.49	8.42
Soap water	7.21	7.21	8.10
Industrial water	7.21	7.78	8.26

5. CONCLUSION

1. The study has evaluated the use of treated waste water for concrete production.
2. The water quality analysis showed thattreatedwastewaterissuitablefor concrete production according to permissiblelimitsofmixingwaterfor concrete.
3. The consistency, initial and final setting time of cement by mixing treated waste water is within the IS limit.
4. The compressive strength of the concrete is increased by mixing treated waste water at the end of 7 days.

5. The preliminary research findings suggested that significant differences do not exist between concrete cubes made of both treated waste water &portablewater.
6. Treated waste water can be used in the preparation of concrete for both casting & curing purposes without affecting the target mean strength of the concrete at the age of 28 days curing for M-20 gradeconcrete.
7. Workability of concrete isgood.
8. With the comparison of concrete preparedwithtreatedwastewaterand portable water gives similarresults.
9. Now a days there is so much scarcity of water i.e. there is a need to arrange other sources of water for concrete or construction of buildingunits.
10. Low cost and environmental friendly concrete can be produced by using treated waste water in concrete.
11. Concrete cost can be reduced by using treated waste water inconcrete.

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